Claims

[c1] 1. A high throughput screening system for evaluating chemical resistance, comprising:

at least one chemical selected from a plurality of chemicals;

a plurality of materials exposable to the chemical;

a plurality of acoustic-wave devices each associated with a corresponding one of the plurality of materials and each having a first acoustic-wave property and a second acoustic-wave property, wherein for each of the plurality of acoustic-wave devices the first acoustic-wave property corresponds to an acoustic-wave property prior to exposure to the corresponding one of the plurality of materials to the chemical and the second acoustic-wave property corresponds to an acoustic-wave property subsequent to exposure to the corresponding one of the plurality of materials to the chemical;

an acoustic-wave property detector for measuring the first acoustic-wave property and the second acoustic-wave property of each of the plurality of acoustic-wave devices; and

an analyzer for determining an acoustic-wave property change between the first acoustic-wave property and the second acoustic-wave property for each of the plurality of materials, wherein for each of the plurality of materials the acoustic-wave property change is correlated to a chemical resistance to the chemical.

[c2] 2. The system of claim 1, wherein the second acoustic-wave property correlates to a mass of dissolved material.

[c3] 3. The system of claim 2, wherein the mass of dissolved material is in the range of about 1×10^{-15} gram to about 1×10^{-3} gram.

[c4] 4. The system of claim 1, where the acoustic-wave device is a one-port device.

[c5] 5. The system of claim 1, where the acoustic wave device is a two-port device.

[c6] 6. The system of claim 1, where the acoustic-wave device is a piezoelectric device.

[c7] 7. The system of claim 6, where the piezoelectric acoustic-wave device is selected from the group consisting of a thickness-shear mode (TSM) device, a surface acoustic wave (SAW) device, an acoustic plate mode (APM) device, a flexural plate wave (FPW) device, and a surface transverse wave (STW) device.

[c8] 8. The system of claim 1, where the acoustic wave device is a non-piezoelectric acoustic-wave device.

[c9] 9. The system of claim 8, where the non-piezoelectric acoustic-wave device is selected from the group consisting of a thin-rod acoustic-wave (TRAW) device, a bimorph device, a unimorph device, a cantilever, a torsion resonator, a tuning fork, and a membrane resonator.

[c10] 10. The system of claim 1, where the acoustic-wave property is selected from the group consisting of fundamental oscillation frequency, harmonic oscillation frequency, impedance phase and magnitude, impedance phase and attenuation, wave velocity and wave attenuation, capacitance, and conductance.

[c11] 11. The system of claim 1, where the acoustic-wave property detector is selected from the group consisting of a frequency counter, a network analyzer, a vector voltmeter, an impedance analyzer, a phase interferometer, and an in-phase and quadrature demodulator.

[c12] 12. The system of claim 1, wherein each of the plurality of materials has a mass, and wherein the mass is in the range of 1×10^{-12} gram to about 1 gram.

[c13]

13. The system of claim 1, wherein the acoustic-wave property change comprises a difference between the first acoustic-wave property and the second acoustic-wave property, wherein the difference in acoustic-wave property corresponds to a time of exposure of the chemical to each

corresponding one of the plurality of materials.

[c14] 14. The system of claim 13, wherein the time of exposure is in the range of about 1 millisecond to about 1 year.

[c15] 15. The system of claim 13, wherein the time of exposure is in the range of about 10 milliseconds to about 24 hours.

[c16] 16. The system of claim 13, wherein the time of exposure is in the range of about 100 milliseconds to about 1 hour.

[c17] 17. The system of claim 1, wherein the plurality of materials are selected from a group consisting of organic materials, polymers, polymers with additives, polyolefins, polycarbonate, polycarbonate blends, silicones, polycarbonate-polyorganosiloxane copolymers, polyetherimide resins, a copolymer of tetrafluoroethylene and perfluoro-2,2-dimethyl-1,3-dioxole, and an amorphous fluoropolymer material.

[c18] 18. The system of claim 1, wherein the plurality of materials are selected from a group consisting of polyolefins, vinyl and vinylidene polymers, natural and synthetic rubbers, polyesters, polycarbonates, cellulose derivatives, fluoropolymers, polyorganosiloxanes, polynitriles, polyamides, polyimides, polyurethanes, polyoxides, polysulfones, polyacetylenes, polyacrylics.

[c19] 19. The system of claim 1, wherein the at least one chemical comprises one selected from a group consisting of an organic solvent, water, fuel, an alkaline solution, an acidic solution, gasoline, a hexane/toluene mixture, a ketone, a glycol ether, a glycol ether ester, a toluene, a methylethyl ketone, an ester solvent, an alcohol, 1-methdyl-2-pyrrolidinone, a xylene, a volatile inert solvent, chloroform, ammonium hydroxide, sodium hydroxide, methanol, acetone, a fluorinated solvent, and perfluoro(2-butyl tetrahydrofuran).

[c20]

20. The system of claim 1, wherein the acoustic-wave property detector is capable of sequential measurement of the second acoustic-wave property for

each of the plurality of acoustic-wave devices.

[c21] 21. The system of claim 1, wherein the second acoustic-wave property differs from the first acoustic-wave property as a function of a mass of an undissolved portion of the corresponding one of the plurality of materials.

[c22] 22. The system of claim 1, wherein the second acoustic-wave property differs from the first acoustic-wave property as a function of a mass of a dissolved portion of the corresponding one of the plurality of materials.

[c23] 23. The system of claim 1, wherein the second acoustic-wave property differs from the first acoustic-wave property as a function of a mass of an undissolved portion of a corresponding one of the plurality of materials and as a function of a mass of absorbed portions of the chemical.

[c24] 24. A system for measuring a variation in each of a plurality of minute samples of materials of interest, the system comprising:

a plurality of acoustic-wave devices, wherein one from the plurality of samples is deposited on each of the plurality of acoustic-wave devices;

at least one oscillation source coupled to each of the plurality of acoustic-wave devices, such that each of the plurality of acoustic-wave devices has an applied oscillation potential, the applied oscillation potential producing in each of the plurality of acoustic-wave devices an acoustic-wave property, wherein the acoustic-wave property for each of the plurality of acoustic-wave devices varies with a variation in the associated deposited sample;

a plurality of acoustic-wave property detectors, each of the plurality of acoustic-wave property detectors associated with at least one from the plurality of acoustic-wave devices; and

at least one processor coupled to the plurality of acoustic-wave property detectors, wherein the at least one processor is capable of calculating the variation in each of the plurality of applied samples as a function of the variation of the associated acoustic-wave property.

[c25] 25. The system of claim 24, wherein each of the plurality of samples comprise a material selected from a group consisting of polyolefins, vinyl and vinylidene polymers, natural and synthetic rubbers, polyesters, polycarbonates, cellulose derivatives, fluoropolymers, polyorganosiloxanes, polynitriles, polyamides, polyimides, polyurethanes, polyoxides, polysulfones, polyacetylenes, and polyacrylics.

[c26] 26. The system of claim 24, wherein each of the plurality of samples comprise a material selected from a group consisting of polyolefins, vinyl and vinylidene polymers, polyesters, polycarbonates, cellulose derivatives, polyorganosiloxanes, polynitriles, polyamides, polyimides, polyurethanes, polyoxides, polysulfones, polyacetylenes, and polyacrylics.

[c27] 27. The system of claim 24, wherein at least one from the plurality of samples comprises a deposited film.

[c28] 28. The system of claim 24, wherein the plurality of acoustic-wave devices comprise a device selected from the group consisting of a thickness-shear mode (TSM) device, a surface acoustic wave (SAW) device, an acoustic plate mode (APM) device, a flexural plate wave (FPW) device, a surface transverse wave (STW) device, thin-rod acoustic wave (TRAW), a bimorph, a unimorph, a cantilever, a torsion resonator, a tuning fork, and a membrane resonator.

[c29] 29. The system of claim 24, wherein the plurality of acoustic-wave devices operate in a frequency range of about 10 GHz to about 0.1 Hz.

[c30] 30. The system of claim 24, wherein the plurality of acoustic-wave devices operate in a frequency range of about 500 MHz to about 1 kHz.

[c31] 31. The system of claim 24, wherein the plurality of acoustic-wave devices operate in a frequency range of about 100 MHz to about 100 KHz.

[c32] 32. The system of claim 24, wherein the oscillation source comprises an oscillating potential.

[c33] 33. The system of claim 24, wherein the variation in the associated applied

sample comprises a change in mass.

[c34] 34. The system of claim 33, wherein the change in mass occurs via absorption of a chemical.

[c35] 35.Th e system of claim 34, wherein the chemical comprises a solvent.

[c36] 36.Th e system of claim 35, wherein the solvent comprises one selected from a group consisting of a hydrocarbon fuel, an alkaline solution, an acidic solution, water, an organic solvent, gasoline, a hexane/toluene mixture, chloroform, ammonium hydroxide, sodium hydroxide, methanol, acetone, and a fluorinated solvent .

[c37] 37.The system of claim 33, wherein the change in mass occurs via dissolution by a chemical.

[c38] 38.The system of claim 24, wherein the measuring of the variation occurs over an exposure time, the exposure time comprising a time in the range of about 10 milliseconds to 24 hours.

[c39] 39.The system of claim 24, wherein the processor comprises one selected from a group consisting of a personal computer, a minicomputer, a microcomputer, an oscilloscope and a mainframe computer.

[c40]

40.A s ystem for measuring a change in mass over time for a plurality of minute samples of materials of interest, wherein each of the plurality of samples has an associated mass, the system comprising:

a plurality of acoustic-wave devices, wherein one from the plurality of samples is associated with a corresponding one of the plurality of acoustic-wave devices;

a plurality of oscillation sources, at least one oscillation source coupled to each of the plurality of acoustic-wave devices such that each of the plurality of acoustic-wave devices has an applied oscillation potential, the applied oscillation potential producing in each of the plurality of acoustic-wave devices an oscillation frequency,

wherein the oscillation frequency for each of the plurality of acoustic-wave devices varies with variation in the mass of the associated applied sample;

at least one acoustic-wave property detector associated with each of the plurality of acoustic-wave devices, each acoustic wave property detector operable to measure the variation in oscillation frequency associated with each acoustic-wave device; and

at least one processor coupled to the at least one acoustic-wave property detector, wherein the at least one processor is capable of calculating the change in mass of each of the plurality of applied samples as a function of the variation of the associated oscillation frequency.

[c41] 41.The system of claim 40, wherein the change in mass calculable by the system is in the range of about 1 picogram to about 1 milligram.

[c42] 42.The system of claim 40, wherein the change in mass calculable by the system is in the range of about 1 nanogram to about 1 microgram.

[c43] 43.The system of claim 40, wherein the at least one processor is operable to correlate the change in mass to a chemical resistance measurement.

[c44] 44.A h igh throughput method of evaluating chemical resistance, comprising:

measuring a first acoustic-wave property of each one of a plurality of acoustic-wave devices associated with each of a plurality of materials, where the first acoustic-wave property corresponds to a property prior to exposure of each of the plurality of materials to a corresponding one of a plurality of chemicals;

exposing each of the plurality of materials to the corresponding one of the plurality of chemicals;

measuring a second acoustic-wave property of each one of the plurality of acoustic-wave devices associated with each of the plurality of materials, where the second acoustic-wave property corresponds to

a property subsequent to exposure to the corresponding one of the plurality of chemicals; and

analyzing an acoustic-wave property change between the first acoustic-wave property and the second acoustic-wave property for each of the plurality of acoustic-wave devices associated with each of the plurality of materials, where the acoustic-wave property change is correlated to a chemical resistance to the corresponding chemical for each of the plurality of materials.

[c45] 45.A m ethod for measuring variation in a plurality of minute samples of materials of interest, the method comprising:

applying an oscillating potential to each of a plurality of acoustic-wave devices prior to a variation in each of the plurality of samples such that each of the plurality of acoustic-wave devices has a first acoustic-wave device oscillation frequency;

applying the oscillating potential to each of the plurality of acoustic-wave devices subsequent to the variation in at least one of the plurality of samples such that each of the plurality of acoustic-wave devices has a second acoustic-wave device oscillation frequency;

determining a difference between the first acoustic-wave device oscillation frequency and the second acoustic-wave device oscillation frequency for each of the plurality of acoustic-wave devices; and

calculating the variation in each of the plurality of applied samples based on the determined difference between the first acoustic-wave device oscillation frequency and the second acoustic-wave device oscillation frequency for each of the plurality of acoustic-wave devices.

[c46] 46.The method of claim 45, where the variation is correlated to a chemical resistance.

[c47]

47.A me thod for measuring mass over time for a plurality of minute samples of materials of interest, wherein each of the plurality of minute samples has an associated mass, the method comprising:

applying an oscillating potential to each of a plurality of acoustic-wave devices prior to a mass variation in each of the plurality of samples such that each of the plurality of acoustic-wave devices has a first acoustic-wave device oscillation frequency;

applying the oscillating potential to each of the plurality of acoustic-wave devices subsequent to a mass variation in at least one of the plurality of samples such that each of the plurality of acoustic-wave devices has a second acoustic-wave device oscillation frequency;

determining a difference between the first acoustic-wave device oscillation frequency and the second acoustic-wave device oscillation frequency for each of the plurality of acoustic-wave devices; and

calculating the variation of mass in each of the plurality of applied samples based on the determined difference between the first acoustic-wave device oscillation frequency and the second acoustic-wave device oscillation frequency for each of the plurality of acoustic-wave devices.

[c48] 48.The method of claim 47, where the variation of mass is correlated to a chemical resistance.

[c49] 49.The method of claim 47, further comprising continuously applying the oscillating potential and continuously measuring the second acoustic-wave device oscillation frequency.